resulting from the melting by the sun of the snow above had percolated down to the hard substratum, along which it had run till it reached the place where the bare earth above it no longer protected it from radiation, and it then cooled and crystallised in this curious way, pushing itself up by expansion in so doing, each layer being the work of one night's frost. If this is correct, it is not difficult to understand what I assume to be the comparative rarity of this form of ice, since it would be seldom that all the necessary conditions would co-exist.

May I add, as the result of seven seasons' experience, that no one who has not tried it knows the charm of Switzerland in October. It is too late, of course, for high ascents, and the flowers are nearly gone; but an ordinary visitor, so long as he avoids the mists and clouds of the lowlands, by keeping at an elevation of three thousand feet and upwards, will find that the brightness and crispness of the air, the *enjoyableness* of the sunshine (which in August can at best be *tolerated*), the purity of the fresh snow, giving grandeur and beauty to lower heights which in summer are mere barren rocks, and the glory of the autumn colouring, not to mention the freedom from the plagues of heat, flies, and tourists, render October in Switzerland the most enjoyable month of the year. B. WOODD SMITH

Hampstead, October 31

The Blackness of Tropical Man

A DECISIVE paper on the subject would have to be prepared elsewhere, but Hindostan presents an excellent field for amassing information with regard to the effects of an extraordinarily powerful sun on the human frame's exterior. In a very interesting article in NATURE for August 21 last (p. 401), "Why Tropical Man is Black," the cause is set down to the nerves of the skin being one and all highly sensitive to light, the optic nerves being merely some of those of the epidermis highly specialised by long-inherited modification, and the necessity for placing over them a pigment which will absorb light. Otherwise the intense nerve vibrations from a light of double degree power would soon degrade the tissues of the individual and exhaust his vitality.

It would have been all the better if a little more had been said about the way in which a patch of dark pigment cells round the transparent skin of the nerve endings, to be exalted into a special sense, heighten the rates of vibration; or how the selected tissue, at the same time securing the transmission of heat, as the constant accumulation of heat waves behind it, throws the molecular constituents of the protoplasm "into the highest rates of vibration possibly obtainable with the means at disposal."

Before turning to the experience India affords, it has to be noticed that, taking the centre of Europe as the standard of whiteness, it is not only going south that the population becomes successively blacker, but that there is a dark-skinned tendency in the races lying in the other direction, towards the Polar regions. Besides this, exposure in the bright days of August on the moors in the British Isles has the effect of browning the white skin exposed to light, and making it on the face and hands for a short time only a shade lighter than the lightest Indians. This can only be by the solar rays producing pigment in the skin.

On the contrary, the experience of Europeans in India is that the sun there does not burn; if anything, it rather whitens them and pales the complexion. It is only on certain occasions, when the sun is obscured by rain-clouds, it is cool, and the diffused light is of a particular but unascertained actinic quality, that the skin of a European is sunburnt. One may ride all day in the hottest sun and have no trace of sunburning.

Also were light the sole cause of a protection for the skin being required, this would be supplied by the clothing Europeans invariably have, except on hands and face; and they would be placed in about the same favourable position as the natives, if not more so, as those of the latter of the class of labourers prefer working almost entirely without clothes.

What is dreaded by Europeans all over India, and extending into Afghanistan, is the "Indian sun," when it is elevated more than ten or fifteen degrees above the horizon; and it is chiefly the head which it affects, and which has to be protected by non-conducting materials, forming the strange head-gear of the tropics. The playing of the sun on the rest of the body is disagreeable, but not dangerous.

Light and heat are one and the same, so that the nerves of sight are only a select number of those with which the skin is full, higher strung; but it is noticeable that, though heat is felt by any nerves of the skin indiscriminately, they are insensible to minute differences of heat, or in the periods of the heat-rays, so that no sense, so to speak, is conveyed by them. That is—though, as we know, all objects reflect as many heat-rays of different kinds as they do visual rays—we are not conscious of their form by a reception and discrimination of the varying periods of the heat-rays; we do not consciously see by heat.

The effect the Indian sun has on European health, sunstroke being said to be the work of a few minutes, shows that the nerves of the skin are sensitive to some rays besides those of light. In fact, the sun's rays of Hindostan must contain rays not found in the sunlight of most other parts of the world, which moreover penetrate the European's white skin tissues and clothing, while the natives can let it beat upon their bared heads with complete impunity.

There has never been a sufficiently minute comparison made between the pure solar diffraction spectrum, from the lowest lines to the highest, of India and that in other countries, such as Great Britain, America, the West Indies, and Australia. In many respects the West India Islands are as tropical as the East Indies, but those who have resided in the former and coming to the latter declare there is some quality they feel in the Indian sun that is absent in the West Indies; they can wear a simple straw hat in the one place, but could not attempt it anywhere throughout India. If the spectra were juxtaposed, it would no doubt be found that groups of rays in some portion of it, whether at the red or the violet end, were present to a much larger extent in the light of the Indian sun than either in Australia or the West Indies. It is of the greatest importance, in order to clear up this question, as well as to science in general, that those who have the means and time should analyse the spectra and give the results.

The only test available is sensation at present, but this is unmistakable, because, in addition to the burning feel of 140° Fahrenheit, there is a peculiarly unpleasant sensation even in the shade, whether it is that of a tree, an umbrella, a thin tent, or even a walled room with a window, if there is no veranda. This can only come from invisible rays to which all but the thickest coverings are pervious, and which the skin and tissues admit freely.

European "colonists" are, happily for themselves, unknown in India, and the race would immediately die out, as it is only by frequent visits to temperate climates that a European can preserve health. But if they did exist it is open to doubt if a white skin would ever become black. It is commonly supposed that the Black Jins of Cochin are converted Hindoos. The difference that a change in dress and diet makes in these is singular, many being termed Portuguese, for example, who are pure natives descended from converts whom the Portuguese for the most part made forcibly.

As a rule, the higher the caste and the higher in the scale a native of India is, the whiter he is; and the lower the caste and hotter the mean temperature of the place, the blacker. But this is not invariably the case, as the outcasts who work in leather in Upper India are rather lighter than some of the Brahmans. However, latitude has most effect, and wherever the sun is hottest all the year round the blacker the natives, down to the equator of heat shown on the atlases. The configuration of the country, however, shows that the shades of colour are due to successive waves of conquest from the north, and the Northern Asiatics, who were nearly white at first, degenerate the farther south they come, and are unfit for labour. A blackness of skin, therefore, confers an immunity from the effects of the sun, so that those having it can labour in the heat in a way that would soon cause the lighter races to give in.

Black radiates quicker than white, and though black coats are by no means unknown to Europeans in India, who are as often in those as in coats of any other colour, the black skin of the labourer would throw off accumulated heat much more quickly than if white, and perhaps in a ratio worth calculating. This must be one of the reasons; and it may be noticed that the exterior of buildings is frequently tinted a slate colour with this view, in India, instead of being whitewashed.

Still a more ready dissipation of heat is not the only advantage imparted by a pigmentary blackness in the human skin; and it is to be inferred that the real protection consists in there being a few of the invisible solar rays of the spectrum in tropical light injurious to man, which nevertheless possess unusual

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penetrative energy, and go through a thickness of what are ordinarily considered opaque substances, but which are intercepted by the contents of the epidermic pigment cells largely developed in the African, a little more sparingly in Hindoos, and not absolutely wanting in the sunburnt excursionist or sportsman in our own country.

The Australian will tell you that he has done hard work—in a shade temperature of 100°—in the sun in a light wideawake and not felt exhausted; while continuous labour of some hours in much less heat—75° in the shade and exposed to the sun—in Hindostan would be simple destruction of the European's powers of exertion with all a Bond Street hatter could devise on his head. A. T. FRASER

Equator of Heat, India, October 1

The Distribution of Scientific Works Published by the British Government

I HAVE read Dr. Valentine Ball's letter in your journal of October 30 (p. 634) expressing his astonishment that the scientific Reports of the British Government are not presented to the leading American scientific institutions. It may surprise Dr. Ball to learn that the Treasury recently refused to present one of the largest scientific libraries in Dublin with copies of the *Challenger* Reports on the ground that their "free list" was too limited! G. F. B.

A NEW METHOD OF HEATING IN THE REGENERATIVE GAS FURNACE

DURING the present age, which may be called that of Electricity, the sister science of Heat is not receiving so much attention at the hands of the natural philosopher as it did formerly. But still there remain some scientific men who are giving a life-long attention to it—MM. Hirn and Berthelot in France, Herren Clausius, Helmholtz, and Frederick Siemens in Germany, Mr. Joule and Sir William Thomson in this country. During the late Sir William Siemens's lifetime, the one brother worked here in the science of Heat, the other in Germany, and the work of both was applied everywhere; now Mr. Frederick Siemens works alone, and, from the recent evidence of that work, it promises to play an important part in the economical application of fuel. Mr. F. Siemens has recently had an opportunity given him of bringing his views forward in this country, having read a paper at the Chester meeting of the Iron and Steel Institute on a new method of heating in the regenerative gas furnace, in which he treated the practical side of the question, whilst in the discussion of the same paper he gave his views on the theory of the subject. Mr. F. Siemens's investigations have led him to the conclusion that combustion can only be perfect, and be maintained perfect, if the space in which it takes place is sufficiently large to allow the gases to combine out of contact with solid materials. Having proved by actual experiment that solid substances interfere with the formation of flame and that flame injures solid substances with which it comes in contact, he brings forward an hypothesis to account for the phenomena. According to the electrical hypothesis, which Mr. Siemens prefers, flame is the result of an infinite number of exceedingly minute electrical flashes, the flashes being due to the exceedingly swift motion of gaseous particles, and a solid body which opposes itself to these flashes is cut by them, whilst, the motion being more or less arrested by the solid body, the flame is damped.

Another important deduction from these investigations is that combustion should be considered in two stages or periods, which may be respectively called active and neutral. In the first the purely chemical combination of the gases takes place, during which, as soon as the temperature of ignition has been reached, the whole of the heat of the highest possible intensity is produced, of which a large portion is given off by radiation, whilst in the second the temperature having fallen in the proportion of the heat given off by radiation, the remainder of the heat which is no longer of an active character, is best transmitted by conduction. For the purpose of utilising this portion of the heat, as well as for raising the temperature of the gas and air before combustion, the regenerators are requisite which form an essential feature of all furnaces worked at an intense heat on the Siemens principle, care being taken to design the furnace so that the gases shall have combined perfectly before the products of combustion are allowed to pass away.

Mr. Siemens in applying his investigations to practice insists that flame must not be allowed to impinge upon bodies to be heated, but must simply heat the bodies by radiation, and furnaces must be so constructed as to allow the flame to develop out of contact, not only with the substance on its bed, but with the walls and roof of the furnace itself; it thus follows that large furnaces must replace small ones, and to meet the objection that the loss of heat into the atmosphere must increase in the proportion of the area of the furnace, Mr. Siemens explains that the heat developed in the furnace increases in a much larger ratio than its increase in area, because flame radiates in every direction from every portion of its entire volume, while a solid substance radiates from its external surface only. The details of construction of metallurgical and glass furnaces and of steam-boilers are given in the paper in question, and need not be considered here; the main point is that furnaces heated on the radiation principle have been proved both in Dresden and at Landore to have been economical of fuel, whilst the saving in the materials treated from reduced oxidation and in the construction of the furnace has been found to be very great.

There is another point of view of this important question which is daily demanding and commanding more attention, and that is the abatement of the smoke nuisance. As is well known, smoke is but incomplete combustion, and the only way to get rid of it is not to produce it. Mr. Siemens insists that this can only be effected by not permitting flame to touch any substance whatever so long as it exists in the active condition; for, just as carbon is precipitated upon a glass rod put into an ordinary gas flame, so is it with any flame whatever its temperature; but the greater the difference of temperature between the flame and the body brought into contact with it the greater will be the amount of smoke produced. Mr. Siemens tells how in Dresden he succeeded in extending his works, without the production of smoke, by the application of the system of heating he recommends, and trusts that here also not only may smoke be abated, but that the public may also derive benefit by manufacturers being able to supply goods at cheaper rates owing to being able to economise their fuel and the material heated within the furnaces as well as that of which the furnaces are constructed.

THE PRIME MERIDIAN CONFERENCE

THE greatly extended and ever increasing intercourse, both commercial and scientific, which has grown up between different nations in modern times has naturally caused especial attention to be drawn to the question of assimilation of the different systems of reckoning employed. Weights and measures and money have been already dealt with more or less successfully, but always with steady advance in the direction of unification. More recently, and in like manner because of practical difficulties and inconveniences, unification of the methods of counting longitude and time has in its turn become a question pressing for solution by the establishment of some international agreement in regard to all matters relating thereto.

The subject became first systematically discussed at the Conference of the International Geodetic Association

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